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Mammalia, Chiroptera, Emballonuridae, *Peropteryx leucoptera* Peters, 1867 and *Peropteryx pallidoptera* Lim, Engstrom, Reid, Simmons, Voss and Fleck, 2010: Distributional range extensions in Ecuador

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ABSTRACT: We reevaluate vouchered records of *Peropteryx leucoptera* in Ecuador with regard to the morphologically similar and newly described species, *P. pallidoptera*. The western-most distributional occurrence of *P. pallidoptera* is documented. Additionally, we describe a new record of *P. leucoptera* collected at Palma Roja, Cuyabeno Faunistic Reserve in Sucumbíos Province, Ecuador that represents the first record for this species in Sucumbíos Province and the northern-most distributional occurrence for Ecuador.

Currently, four of the five species of *Peropteryx* Peters, 1867 are known to occur within the country of Ecuador (*P. trinitatis* Miller, 1899 is distributed from Trinidad and Venezuela east to French Guiana; Simmons 2005): *P. kappleri* Peters, 1867 has been documented in western Ecuador, whereas *P. macrotis* (Wagner, 1843) and the recently described *P. pallidoptera* Lim *et al*., 2010 are restricted to east of the Andes (Albuja 1999; Tirira 2007; Hood and Gardner 2008; Lim *et al.* 2010). Although *Peropteryx leucoptera* Peters, 1867 has recently been collected in eastern Ecuador (Arcos *et al.* 2007), it has not been compared to the morphologically similar new species, *P. pallidoptera.* Herein, we reevaluate known records of *P. leucoptera* in Ecuador in light of this new species and provide the first record of *P. leucoptera* for Sucumbíos Province.

Peropteryx leucoptera was originally described from a specimen collected in Suriname (Peters 1867). Subsequently, this species was classified in its own subgenus *Peronymus* (Peters 1868), which was then later recognized as a genus (Miller 1907; Sanborn 1937; Corbet and Hill 1991). However, some taxonomic references still assign it to the rank of subgenus (Cabrera 1958; Simmons 2005). Recent evidence demonstrates that this species forms a monophyletic group with other *Peropteryx* (Lim *et al*. 2008) and supports the recognition of *Peronymus* as a junior synonym of *Peropteryx* (Hood and Gardner 2008; Lim *et al*. 2010). Two subspecies are recognized including *P. l. leucoptera* from Colombia, Venezuela, Guyana, Suriname, French Guiana, and Brazil (Hood and Gardner 2008), and *P. l. cyclops* from Peru (Thomas 1924). However, the subspecies boundaries in the western Amazon are unclear.

The genus *Peropteryx* is characterized by a small wing sac located near the anterior border of the antebrachial membrane, opening distally; an expanded rostrum; a distinct angle between the rostrum and the forehead; a basisphenoid pit that is not divided by a median septum, and a spike-like first upper premolar (Jones and Hood 1993). Compared with *P. kappleri*, *P. macrotis* and *P. trinitatis*—*P. leucoptera* and *P. pallidoptera* are characterized by white or pale wings beyond the forearm (Lim *et al*. 2010). However, *P. leucoptera* is distinguished by wings that gradually darken to brown from the wing tips to the body as compared to a uniform pale brown wing for *P. pallidoptera*. In addition, *P. leucoptera* is further distinguished from other species of *Peropteryx* by the possession of large pterygoid pits and ears connected by a low band across the forehead (Sanborn 1937; Goodwin and Greenhall 1961; Husson 1962, 1978; Jones and Hood 1993; Lim *et al*. 2010).

On 22 June 2006, one subadult female *P. leucoptera* was captured by L. K. Ammerman (LKA 078) in Sucumbíos Province at the Cuyabeno Faunistic Reserve, Palma Roja (0°1'5.23" S, 76°9'54.48" W, 256 m elevation) (Figure 1). This locality consists of varzea forest southeast of the Laguna Grande in the Reserva de Producción Faunística Cuyabeno. The specimen was captured at 18:30 h using a mistnet placed on a forest path near a large, fallen, hollow tree. Other species captured in the same net were *Saccopteryx bilineata* (Temminck, 1838) and *Artibeus obscurus* (Schinz, 1821). Specimens were collected under Permit No. 016 IC-FAU-DNBAPVS/MA issued by the Ministerio del Ambiente of Ecuador. The specimen was fluid preserved in alcohol with the skull extracted

and deposited in the Mammalogy Division of Museo de Zoología at the Pontificia Universidad Católica del Ecuador, Quito, Ecuador (QCAZ 8478). Tissues (heart, kidney and liver) were preserved in lysis buffer (Longmire *et al.* 1997) and deposited at the Angelo State Natural History Collection, Angelo State University, San Angelo, Texas, USA (ASK 7645).

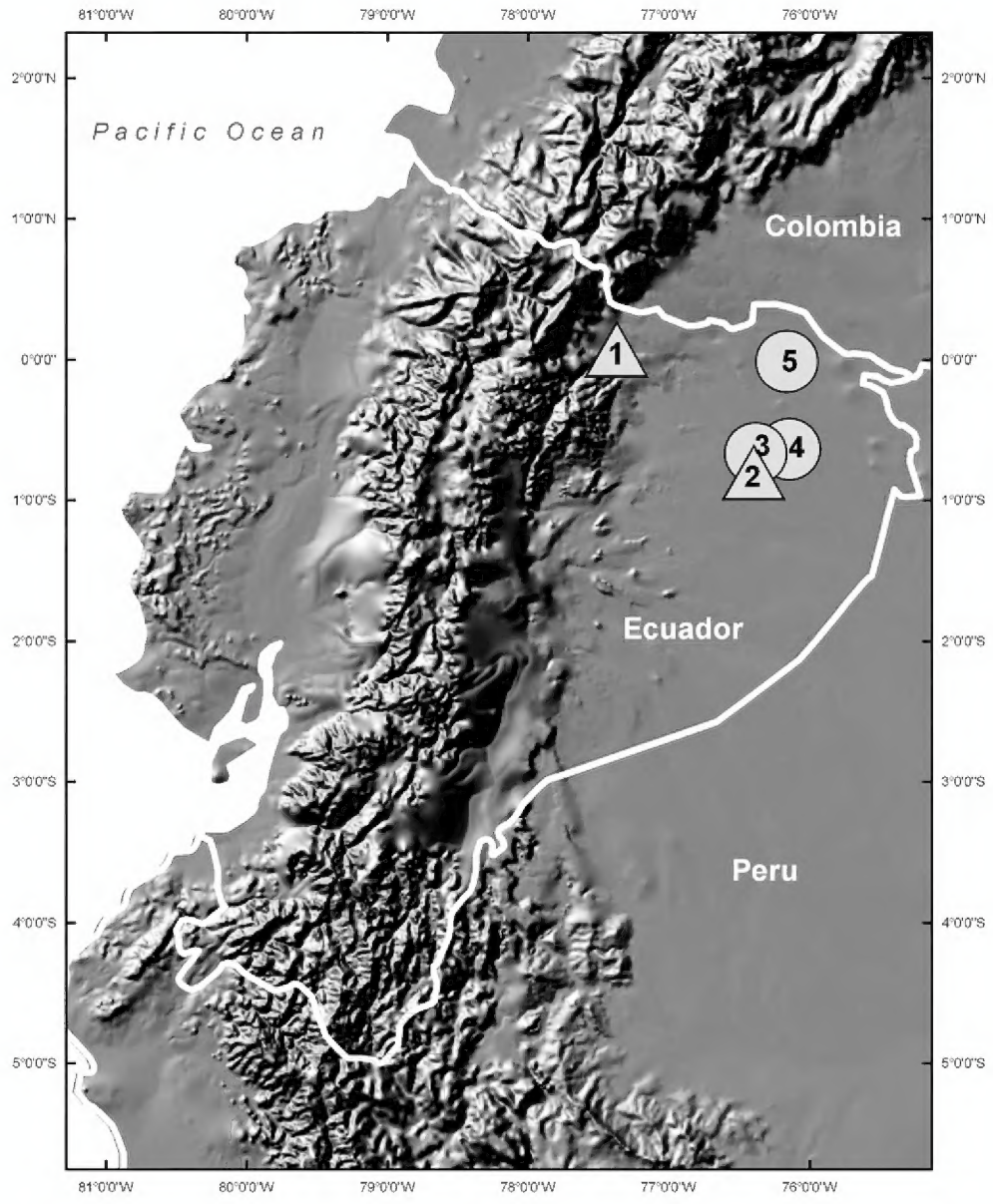

FIGURE 1. Distribution of records of *Peropteryx leucoptera* (circles) and *Peropteryx pallidoptera* (triangles) in Ecuador. 1) record of *P. pallidoptera* (MEPN 9913) originally reported as *P. leucoptera* 0°2'4.17"N, 71°24'13.93"W (Arcos *et al.* 2007); 2) holotype of *P. pallidoptera* 00°48'S, 76°24'W (Lim *et al.* 2010); 3) record of *P. leucoptera* (MEPN 9869) from Tiputini River (Arcos *et al.* 2007); 4) purported record of *P. leucoptera* from Tiputini Biological Station (Rex *et al.* 2008); 5) new record of *P. leucoptera* (QCAZ 8478) from Sucumbíos Province, Ecuador.

External measurements (in millimeters) recorded in the field included total length (TL), length of tail (T), length of hindfoot (HF), length of ear (E), length of forearm (FA), and mass (in grams) (W) (Table 1). Cranial measurements (in mm) were recorded with digital calipers taken to the nearest 0.01 mm and included greatest length of skull, including incisors (GLS), condyloincisive length (CIL), breadth across zygomatic arches (ZB), breadth across mastoids (MB), breadth across braincase (BBC), width across postorbital constriction (POC), length of maxillary toothrow from canine to third molar (CM3), and breadth across upper molars (M3M3) (Table 1).

Earlier reports of *P. leucoptera* in Orellana Province of Ecuador include the capture of one female individual (deposited at the Museo de la Escuela Politécnica Nacional—MEPN 9869) near the Rio Tiputini (0°41'58.12" S, 76°23'8.41" W, 250 m) (Arcos *et al.* 2007, published as MEPN 5941—which likely corresponds to the field preparation number) as well as the unvouchered report of five individuals from Tiputini Biological Station (0°38'18.60" S, 76°8'55.20" W, 200 m elevation) (Rex *et al.* 2008). An additional record, initially described as *P. leucoptera* by Arcos *et al.* (2007) (MEPN 9913) was reexamined and, based on the characters presented in Lim *et al.* (2010)—gradation of wing coloration, size of pterygoid pits, and presence or absence of band across ears—this specimen was determined to be a female *P. pallidoptera*. Specimen MEPN 9913 was collected in Bosque del Aguarico, 20 km from Lumbaqui, and represents a western range extension for the species.

External measurements of specimens of *P. leucoptera* (MEPN 9869 and QCAZ 8478) and *P. pallidoptera* (MEPN 9913) from Ecuador as well as the three other species of *Peropteryx* that occur in Ecuador are presented in Table 1. The total length for QCAZ 8478 is slightly smaller and the forearm length is slightly larger compared to measurements available for other female *P. leucoptera*; however, the specimen is a subadult as indicated by the incomplete ossification of the epiphyseal joints in the wings and sample sizes are low. Although small sample sizes have hindered the study of sexual dimorphism in species of *Peropteryx*, it seems that females are larger than males in *P. macrotis, P. trinitatis*, and *P. kappleri* but not in *P. pallidoptera* (Lim *et al.* 2010). The external measurements overlapped broadly in *P. leucoptera*, but we did not have any other cranial material of female *P. leucoptera* for comparison; however, the female specimen from Ecuador (QCAZ 8478) was larger than 6 of the 8 measurements for males. Nonetheless, the female specimen from Ecuador was still outside the range for 5 of the 8 measurements reported for the other species in the genus (Table 1). Compared with the type specimen of the larger subspecies *P. l. cyclops* (adult male; BMNH [British Museum of Natural History] 24.3.1.6; TL=65, T=15, E=17, FA=44.8, GLS=16.3, MB=9.2, POC=3.2, CM3=6.5, M3M3=7.6) from Peru (Thomas 1924; Carter and Dolan 1978), the subadult female *P. leucoptera* from Ecuador (QCAZ 8478) is smaller except for a slightly larger forearm (46.4) and postorbital constriction (3.4) (Table 1). Photographs of the specimen QCAZ 8478 from Ecuador (Figure 2) demonstrate the characteristic white wings, ears connected by a low band across forehead, and large pterygoid pits for the species. However, there is slight morphological variation in the shape and size of the pterygoid pits in *P. leucoptera*.

DNA sequences were generated for QCAZ 8478 from the mitochondrial cytochrome-*b* gene following the protocol used by Lim *et al.* (2008) and deposited in GenBank (HM367876). The complete gene region of 1,140 base pairs was compared to previously published sequences on GenBank (Table 2) to confirm identification of this specimen. Species from the closely related genera of *Balantiopteryx* Peters, 1867, *Cormura* Peters, 1867, *Cyttarops* Thomas, 1913, and *Diclidurus* Wied-Neuwied, 1820 were used as outgroup taxa (Lim *et al.* 2008). Phylogenetic relationships were inferred using a maximum parsimony approach as implemented in PAUP* (Swofford 2001). Nucleotide characters were treated as unordered and unweighted with optimal trees searched using a heuristic algorithm. In addition to default options, sequence addition was random and branch support was calculated by bootstrapping from 1,000 replications. Equally parsimonious solutions were summarized with a strict consensus tree.

Table 1. Skin and skull measurements (in mm) of specimens of *Peropteryx leucoptera* (QCAZ 8478, MEPN 9869) and *P. pallidoptera* (MEPN 9913) from Ecuador in comparison to the mean and range (in parentheses, if more than two individuals) for each sex (sample size in parentheses) of the four species of *Peropteryx* that range into Ecuador (Lim *et al.* 2010).

	Sex	*P. kappleri* (M=14; F= 17)	*P. macrotis* (M=10; F=13)	*P. pallidoptera* (M=2; F=14)	*P. pallidoptera* (MEPN 9913)	*P. leucoptera* (M=14; F=7)	*P. leucoptera* (MEPN 9869)	*P. leucoptera* (QCAZ 8478)
TL	M	70.2 (65-76)	58.2 (53-62)	59.5 (57-62)		63.5 (56-69)		
	F	74.0 (68-82)	63.0 (59-65)	63.0 (58-67)	55.0	64.3 (61-66)	62	54
T	M	13.2 (9-17)	12.8 (11-15)	13 (11-15)		12.6 (5-16)		
	F	14.1 (10-17)	13.6 (12-18)	12.7 (11-14)	12.0	13.9 (12-17)	12.5	12
HF	M	10.8 (9-12)	8.3 (7-10)	9		8.8 (7-10)		
	F	11.3 (9-13)	8.8 (8-10)	9.3 (8-10)	7.0	8.8 (8-10)	7.0	10
E	M	18.1 (17-20)	14.5 (14-16)	15		16.8 (13-20)		
	F	17.8 (14-19)	15.2 (14-16)	15.4 (15-17)	14.5	16.6 (15-18.5)	18.0	17
FA	M	48.9 (47-51)	43.4 (39.7-46)	39.5 (39-40)		43.5 (41-46)		
	F	51.5 (50-54)	46.3 (45-48)	42.1 (41-43)	42.0	43.9 (42-45)	42.2	46.4
W	M	7.8 (6.7-8.7)	4.6 (3.8-5)	4.15 (4.0-4.3)		6.6 (4.0-8.5)		
	F	9.0 (7-11.6)	5.6 (5-7)	5.3 (4.5-6.0)	4.7	6.6 (5.5-7.8)	6.5	8.5
GLS	M	18.2	14.5 (14.3-15.2)	14.1		15.3 (14.9-15.6)		
	F	17.5	15.4 (15.0-15.9)	13.9 (13.6-14.1)				15.8
CIL	M	16.4	13.2 (12.7-13.7)	12.5		14.0 (13.9-14.1)		
	F	16.25 (16.2-16.3)	14.0 (13.6-14.6)	12.6 (12.2-12.8)				14.8
ZB	M	10.1 (9.9-10.3)	8.1 (7.6-8.4)	8.15 (8.1-8.2)		9.5 (9.3-9.6)		
	F	10.3 (10.2-10.4)	8.6 (8.3-8.9)	8.3 (8.0-8.7)				10.2
MB	M	8.5 (8.4-8.6)	7.2 (7.0-7.5)	7.25 (7.2-7.3)		7.8 (7.6-8.0)		
	F	8.4 (8.3-8.5)	7.8 (7.4-8.0)	7.2 (6.9-7.4)				7.9
BBC	M	7.7	6.6 (6.2-6.9)	6.45 (6.4-6.5)		7.2 (7.0-7.3)		
	F	7.45 (7.4-7.5)	6.9 (6.7-7.0)	6.5 (6.3-6.7)				7.1
POC	M	2.9 (2.8-2.9)	2.8 (2.4-3.1)	2.8 (2.6-2.9)		3.3 (3.1-3.3)		
	F	2.9 (2.8-3.0)	2.9 (2.6-3.1)	2.7 (2.6-2.9)				3.4
CM3	M	6.9 (6.6-7.2)	5.4 (4.5-5.9)	5.2 (5.0-5.3)		6.1 (6.1-6.2)		
	F	7.3 (7.1-7.5)	5.9 (5.7-6.2)	5.3 (5.0-5.5)				6.5
M3M3	M	7.7 (7.5-7.8)	5.9 (5.7-6.4)	5.9 (5.8-5.9)		6.9 (6.7-7.0)		
	F	7.9 (7.7-8.1)	6.5 (6.2-6.8)	6.0 (5.7-6.4)				7.4

Figure 2. Photograph of the subadult female *Peropteryx leucoptera* (QCAZ 8478) demonstrating (a) the white transparent wing membranes beyond the forearm, (b) band across the forehead connecting the ears, and (c) large pterygoid pits at the base of the skull.

Table 2. Taxonomic sampling for the phylogenetic analysis of *Peropteryx* and outgroup taxa including species, locality, associated voucher specimen, and GenBank accession number for the complete 1,140 base pair cytochrome-b sequence. Museum of deposition for specimen tissues are: AMNH, American Museum of Natural History, New York, USA; FN and ROM, Royal Ontario Museum, Toronto, Canada; MUSM, Museo de Historia Natural de la Universidad Nacional Mayor de San Marcos, Lima, Peru; and QCAZ, Pontifíca Universidad Católica del Ecuador, Quito, Ecuador.

Species	Country; locality	Specimen	GenBank
Balantiopteryx io	Guatemala; Poptun	ROM 99231	EF584153
Cormura brevirostris	Ecuador; Parque Nacional Yasuni	ROM 105746	EF584158
Cyttarops alecto	Guyana; Ceiba Biological Center	ROM 113761	EF584162
Diclidurus isabellus	Guyana; Iwokrama Forest	ROM 108940	EF584165
Peropteryx kappleri	French Guiana; Paracou	AMNH 267834	EF584169
Peropteryx kappleri	Guyana; Baramita	ROM 100910	EF584168
Peropteryx leucoptera	Ecuador; Palma Roja	QCAZ 8478	HM367876
Peropteryx leucoptera	French Guiana; Paracou	AMNH 267839	EF584173
Peropteryx leucoptera	Guyana; Ceiba Biological Center	ROM 112531	EF584175
Peropteryx leucoptera	Guyana; Ceiba Biological Center	ROM 113612	EF584174
Peropteryx leucoptera	Guyana; Iwokrama Forest	ROM 107458	EF584172
Peropteryx macrotis	Guyana; Iwokrama Forest	ROM 108467	EF584180
Peropteryx macrotis	Guyana; Iwokrama Forest	ROM 108523	EF584179
Peropteryx macrotis	Guyana; Iwokrama Forest	ROM 107126	EF584178
Peropteryx macrotis	Mexico; Tulum	FN33843	EF584177
Peropteryx macrotis	Mexico; Loltun	ROM 96446	EF584176
Peropteryx pallidoptera	Ecuador; Parque Nacional Yasuni	ROM 104396	EF584170
Peropteryx pallidoptera	Peru; Nuevo San Juan	MUSM 13228	EF584171
Peropteryx trinitatis	Venezuela; Pozon	ROM 107822	EF584181
Peropteryx trinitatis	Venezuela; Hato La Florida	ROM 107920	EF584182

The white-winged *Peropteryx* from Ecuador (QCAZ 8478) clustered within a well-supported monophyletic clade of *P. leucoptera* (Figure 3). Other phylogenetic relationships were similar to the original study by Lim *et al*. (2008) including an unresolved arrangement involving *P. kappleri, P. macrotis*, and *P. trinitatis* that requires more systematic attention. This clade has *P. pallidoptera* and *P. leucoptera* as successively basal species. The basal relationships were not well supported but this is an artifact of nucleotide saturation at the third codon position of a relatively old lineage, which originated approximately 19.4 million years ago for *Peropteryx* (Lim 2007).

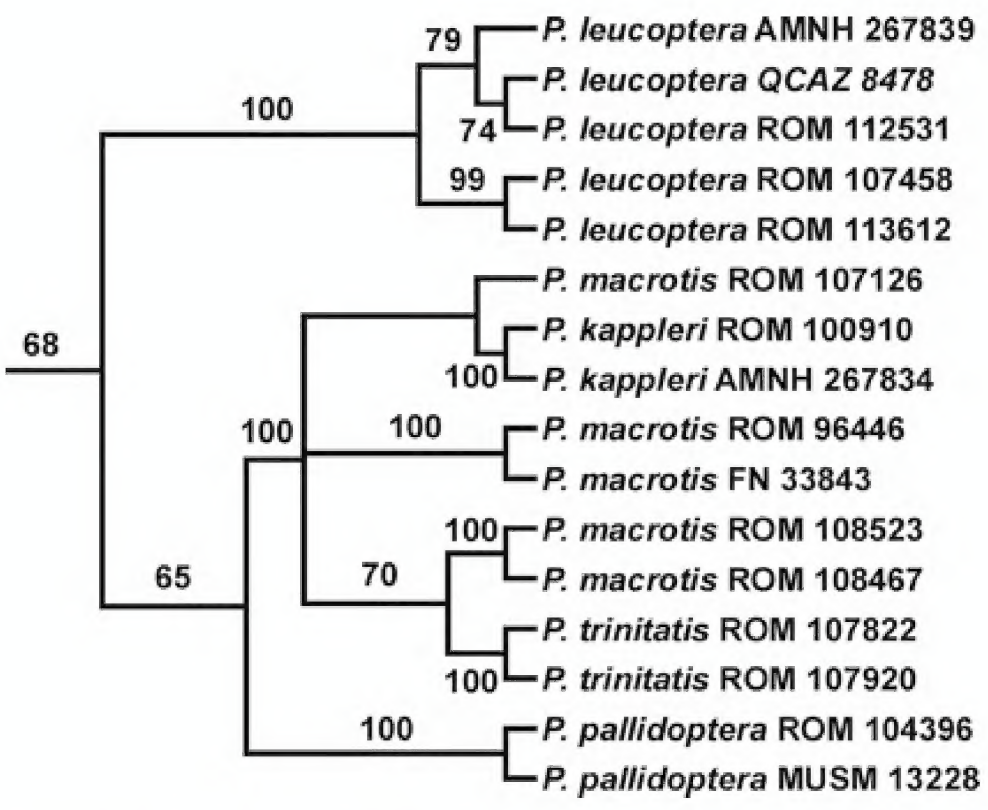

Figure 3. Cytochrome-b tree depicting the phylogenetic position of the Ecuadorian specimen (QCAZ 8478) in relation to other *Peropteryx leucoptera* and *Peropteryx species*. Museum specimen number follows the species name. Numbers along the branches are bootstrap support percentages.

Our paper reevaluates the distribution of *P. leucoptera* in Ecuador with respect to the newly described *P. pallidoptera*. Herein, we verified known voucher records, confirmed species identifications, documented the western-most record of *P. pallidoptera*, and reported the first record of *P. leucoptera* for Sucumbíos Province. This specimen also represents the northern-most record for the country of Ecuador.

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